

DOCKET NO. DALL13-00004

PATENT

SYSTEM FOR ALLOCATING RESOURCES IN A PROCESS SYSTEM
AND METHOD OF OPERATING THE SAME

Inventor(s):

Charlie Wen-Tsann Chen
5926 Warm Mist Lane
Dallas County
Dallas, Texas 75248
United States Citizen

Assignee:

DALLAS/FORT WORTH TECHNOLOGY, INC.
1110 E. Collins Blvd.
Suite 122
Richardson, Texas 75081

CERTIFICATE OF EXPRESS MAIL

I hereby certify that this correspondence, including the attachments listed, is being mailed in an envelope addressed to Commissioner of Patents and Trademarks, Washington, DC 20231, using the Express Mail Post Office to Addressee service of the United States Postal Service on the date shown below.

William A. Munck
Printed Name of Person Mailing
William A. Munck
Signature of Person Mailing

EL 749592625 US
Express Mail Receipt No.
December 1, 2000
Date

William A. Munck
John T. Mockler
Novakov, Davis & Munck, P.C.
13155 Noel Road, Suite 900
Dallas, Texas 75240
(214) 922-9221

SYSTEM FOR ALLOCATING RESOURCES IN A PROCESS SYSTEM
AND METHOD OF OPERATING THE SAME

TECHNICAL FIELD OF THE INVENTION

5 The present invention is directed generally to resource allocation systems and, more specifically, to systems for allocating a plurality of resources among a plurality of tasks within a process system wherein the plurality of resources comprises both human resources and process resources, as well as
10 methods of operating the same.

BACKGROUND OF THE INVENTION

15 Process resource allocation is, by conventional thought, the management (i.e., control, administration, command, direction, governance, monitor, regulation, etc.) of process resources (e.g., hardware, software, databases, communication/connectivity resources, transportation resources, facilities, utilities, inventories, etc.) among a variety of tasks within a process system.

20 Process systems may be arranged and implemented to manage large facilities, such as a manufacturing plant, a mineral or crude oil refinery, or the like, as well as relatively smaller facilities, such as a corporate intranetwork, data repository and

management system, or the like. Such systems may be distributed or not, and typically include numerous modules tailored to manage various associated processes, wherein conventional means link these modules together to produce the distributed nature of the process system. This affords increased performance and a capability to expand or reduce the process system to satisfy changing needs.

Information technology management providers develop process systems that can be tailored to satisfy wide ranges of process requirements, whether global, local or otherwise, and regardless of facility type. Such information technology management providers commonly have two principles objectives, (i) to centralize control of as many processes as possible to improve overall efficiency and (ii) to support a common interface that communicates data among various modules controlling or monitoring the processes, and also with any such centralized controller.

Each process, or group of associated processes, has certain input (e.g., data, diagnostics, flow, feed, power, etc.) and output (e.g., data, utilization parameters, temperature, pressure, etc.) characteristics associated with it. These characteristics are measurable such input and out put values may be measured, represented in a discernable manner. In recent years, predictive control techniques have been used to optimize certain processes as

a function of such characteristics in short, modeling and allocating process resources in response to the same. Predictive control techniques may use algorithmic representations of certain processes to estimate characteristic values (represented as
5 parameters, variables, etc.) associated with them that can be used to better manage, particularly allocation, of such process resources among a plurality of tasks.

6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
A problem however exists in that such optimization efforts are inherently flawed because each only accounts mathematically for the tasks to be performed and the process resources (e.g., hardware, software, databases, communication/connectivity resources, transportation resources, facilities, utilities, inventories, etc.) to resolve the same, thereby failing to model and factor into the optimization effort human resources (i.e., services, functions, activities, skills, qualifications, task preferences, track records and the like perform by human beings) that ultimately utilize the process resources to resolve the tasks. Conventional approaches therefore exhibit poor response to emergency situations or extreme circumstances, and as such fail to provide a cooperative approach that optimizes not only process resources, but also human resources. What is needed in the art is a powerful and flexible means for dynamically optimizing processes as a whole in a real-time mode through allocation of both process resources and human

resources among a plurality of tasks within a process system.

Put another way, the ultimate measurement of an implemented process system is how quickly the demands of requesting tasks can be satisfied through the allocation of process (and needed, but unallocated, human) resources. Today, even though "human resources" are on-site and ready to assist in the allocation of process resources to such requesting tasks, decisions to allocate the human resources are controlled largely by management (whether human management based upon periodic (e.g., daily, weekly, monthly or, even, quarterly) reports, or automated management based upon periodic batched data, or some combination of the two) based upon aged data management reacts based upon stale data, rather than reacting dynamically.

Therefore, a further need exists for a process system/management interface through which management could react more timely relative to conventional systems based upon dynamic data, and, in the event that management does not respond timely to a request of a particular task, the process system would undertake the steps necessary for allocation of both process resources and human resources to such task.

SUMMARY OF THE INVENTION

To address the above-discussed deficiencies of the prior art, it is a primary object of the present invention to provide systems, as well as methods of operating the same, for allocating a plurality of resources, both process and human resources, among a plurality of tasks within a process system. Broadly, such systems and methodologies enable real-time process automation through mathematical modeling of human resources (i.e., services, functions, activities, skills, qualifications, task preferences, track records and the like perform by human beings) and process resources (e.g., hardware, software, databases, communication/connectivity resources, transportation resources, facilities, utilities, inventories, etc.), and then allocating ones of such resources to perform various tasks within the process system. It should be noted that such systems and methodologies may be suitably arranged to maintain a knowledge database and to modify the same to record past experiences thereby enabling the same to be self-learning.

In accord with the principles of the present invention, a resource allocator is introduced that is operable to allocate a plurality of resources among a plurality of tasks within a process system, wherein the plurality of resources includes both human resources and process resources and wherein the process system

includes a plurality of application processes. The resource allocator includes a memory, a status-monitoring controller, and a resource allocation controller.

An exemplary memory in accord herewith is operable to store a model of the process system, wherein the model (i) represents mathematically the plurality of application processes, the plurality of resources, and the plurality of tasks, and (ii) defines various relationships among related ones thereof (e.g., application processes, resources, tasks, etc.): An exemplary status-monitoring controller in accord herewith is operable to monitor measurable characteristics associated with ones of the process system, the application processes, the resources, and the tasks. An exemplary resource allocation controller in accord herewith, and in response to ones of the monitored measurable characteristics, is operable to: (i) modify ones of the mathematical representations and (ii) allocate ones of the resources among ones of the tasks within the process system. In a related embodiment, a suitably arranged graphical user interface ("GUI") is associated with the process system. The GUI is operable to transform real-time process system information into an audio or a visual format to enable supervisor (i.e., human management, system management (self-learning or otherwise), or some suitable combination of human and system management) interaction.

Before undertaking a DETAILED DESCRIPTION OF THE INVENTION, it may be advantageous to set forth a definition of certain words and phrases used throughout this patent document: the terms "include" and "comprise," as well as derivatives thereof, mean inclusion without
5 limitation; the term "or," is inclusive, meaning and/or; the phrases "associated with" and "associated therewith," as well as derivatives thereof, may mean to include, be included within, interconnect with, contain, be contained within, connect to or with, coupled to or with, be communicable with, cooperate with, interleave, juxtapose, be proximate to, be bound to or with, have, have a property of, or the like; the term "memory" means any storage device, combination of storage devices, or part thereof whether centralized or distributed, whether locally or remotely; and the terms "controller" and "allocator" mean any device, system
10 or part thereof that controls at least one operation, such a device, system or part thereof may be implemented in hardware, firmware or software, or some combination of at least two of the same. It should be noted that the functionality associated with any particular controller or allocator may be centralized or
15 distributed, whether locally or remotely. In particular, a controller or allocator may comprise one or more data processors, and associated input/output devices and memory that execute one or more application programs and/or an operating system program.

Additional definitions for certain words and phrases are provided throughout this patent document, those of ordinary skill in the art should understand that in many, if not most instances, such definitions apply to prior, as well as future uses of
5 such defined words and phrases.

6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
260
261
262
263
264
265
266
267
268
269
270
271
272
273
274
275
276
277
278
279
280
281
282
283
284
285
286
287
288
289
290
291
292
293
294
295
296
297
298
299
300
301
302
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
334
335
336
337
338
339
340
341
342
343
344
345
346
347
348
349
350
351
352
353
354
355
356
357
358
359
360
361
362
363
364
365
366
367
368
369
370
371
372
373
374
375
376
377
378
379
380
381
382
383
384
385
386
387
388
389
390
391
392
393
394
395
396
397
398
399
400
401
402
403
404
405
406
407
408
409
410
411
412
413
414
415
416
417
418
419
420
421
422
423
424
425
426
427
428
429
430
431
432
433
434
435
436
437
438
439
440
441
442
443
444
445
446
447
448
449
450
451
452
453
454
455
456
457
458
459
460
461
462
463
464
465
466
467
468
469
470
471
472
473
474
475
476
477
478
479
480
481
482
483
484
485
486
487
488
489
490
491
492
493
494
495
496
497
498
499
500
501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516
517
518
519
520
521
522
523
524
525
526
527
528
529
530
531
532
533
534
535
536
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
557
558
559
560
561
562
563
564
565
566
567
568
569
570
571
572
573
574
575
576
577
578
579
580
581
582
583
584
585
586
587
588
589
590
591
592
593
594
595
596
597
598
599
600
601
602
603
604
605
606
607
608
609
610
611
612
613
614
615
616
617
618
619
620
621
622
623
624
625
626
627
628
629
630
631
632
633
634
635
636
637
638
639
640
641
642
643
644
645
646
647
648
649
650
651
652
653
654
655
656
657
658
659
660
661
662
663
664
665
666
667
668
669
670
671
672
673
674
675
676
677
678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695
696
697
698
699
700
701
702
703
704
705
706
707
708
709
710
711
712
713
714
715
716
717
718
719
720
721
722
723
724
725
726
727
728
729
730
731
732
733
734
735
736
737
738
739
740
741
742
743
744
745
746
747
748
749
750
751
752
753
754
755
756
757
758
759
760
761
762
763
764
765
766
767
768
769
770
771
772
773
774
775
776
777
778
779
780
781
782
783
784
785
786
787
788
789
790
791
792
793
794
795
796
797
798
799
800
801
802
803
804
805
806
807
808
809
810
811
812
813
814
815
816
817
818
819
820
821
822
823
824
825
826
827
828
829
830
831
832
833
834
835
836
837
838
839
840
841
842
843
844
845
846
847
848
849
850
851
852
853
854
855
856
857
858
859
860
861
862
863
864
865
866
867
868
869
870
871
872
873
874
875
876
877
878
879
880
881
882
883
884
885
886
887
888
889
890
891
892
893
894
895
896
897
898
899
900
901
902
903
904
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
921
922
923
924
925
926
927
928
929
930
931
932
933
934
935
936
937
938
939
940
941
942
943
944
945
946
947
948
949
950
951
952
953
954
955
956
957
958
959
960
961
962
963
964
965
966
967
968
969
970
971
972
973
974
975
976
977
978
979
980
981
982
983
984
985
986
987
988
989
990
991
992
993
994
995
996
997
998
999
1000
1001
1002
1003
1004
1005
1006
1007
1008
1009
1010
1011
1012
1013
1014
1015
1016
1017
1018
1019
1020
1021
1022
1023
1024
1025
1026
1027
1028
1029
1030
1031
1032
1033
1034
1035
1036
1037
1038
1039
1040
1041
1042
1043
1044
1045
1046
1047
1048
1049
1050
1051
1052
1053
1054
1055
1056
1057
1058
1059
1060
1061
1062
1063
1064
1065
1066
1067
1068
1069
1070
1071
1072
1073
1074
1075
1076
1077
1078
1079
1080
1081
1082
1083
1084
1085
1086
1087
1088
1089
1090
1091
1092
1093
1094
1095
1096
1097
1098
1099
1100
1101
1102
1103
1104
1105
1106
1107
1108
1109
1110
1111
1112
1113
1114
1115
1116
1117
1118
1119
1120
1121
1122
1123
1124
1125
1126
1127
1128
1129
1130
1131
1132
1133
1134
1135
1136
1137
1138
1139
1140
1141
1142
1143
1144
1145
1146
1147
1148
1149
1150
1151
1152
1153
1154
1155
1156
1157
1158
1159
1160
1161
1162
1163
1164
1165
1166
1167
1168
1169
1170
1171
1172
1173
1174
1175
1176
1177
1178
1179
1180
1181
1182
1183
1184
1185
1186
1187
1188
1189
1190
1191
1192
1193
1194
1195
1196
1197
1198
1199
1200
1201
1202
1203
1204
1205
1206
1207
1208
1209
1210
1211
1212
1213
1214
1215
1216
1217
1218
1219
1220
1221
1222
1223
1224
1225
1226
1227
1228
1229
1230
1231
1232
1233
1234
1235
1236
1237
1238
1239
1240
1241
1242
1243
1244
1245
1246
1247
1248
1249
1250
1251
1252
1253
1254
1255
1256
1257
1258
1259
1260
1261
1262
1263
1264
1265
1266
1267
1268
1269
1270
1271
1272
1273
1274
1275
1276
1277
1278
1279
1280
1281
1282
1283
1284
1285
1286
1287
1288
1289
1290
1291
1292
1293
1294
1295
1296
1297
1298
1299
1300
1301
1302
1303
1304
1305
1306
1307
1308
1309
1310
1311
1312
1313
1314
1315
1316
1317
1318
1319
1320
1321
1322
1323
1324
1325
1326
1327
1328
1329
1330
1331
1332
1333
1334
1335
1336
1337
1338
1339
1340
1341
1342
1343
1344
1345
1346
1347
1348
1349
1350
1351
1352
1353
1354
1355
1356
1357
1358
1359
1360
1361
1362
1363
1364
1365
1366
1367
1368
1369
1370
1371
1372
1373
1374
1375
1376
1377
1378
1379
1380
1381
1382
1383
1384
1385
1386
1387
1388
1389
1390
1391
1392
1393
1394
1395
1396
1397
1398
1399
1400
1401
1402
1403
1404
1405
1406
1407
1408
1409
1410
1411
1412
1413
1414
1415
1416
1417
1418
1419
1420
1421
1422
1423
1424
1425
1426
1427
1428
1429
1430
1431
1432
1433
1434
1435
1436
1437
1438
1439
1440
1441
1442
1443
1444
1445
1446
1447
1448
1449
1450
1451
1452
1453
1454
1455
1456
1457
1458
1459
1460
1461
1462
1463
1464
1465
1466
1467
1468
1469
1470
1471
1472
1473
1474
1475
1476
1477
1478
1479
1480
1481
1482
1483
1484
1485
1486
1487
1488
1489
1490
1491
1492
1493
1494
1495
1496
1497
1498
1499
1500
1501
1502
1503
1504
1505
1506
1507
1508
1509
1510
1511
1512
1513
1514
1515
1516
1517
1518
1519
1520
1521
1522
1523
1524
1525
1526
1527
1528
1529
1530
1531
1532
1533
1534
1535
1536
1537
1538
1539
1540
1541
1542
1543
1544
1545
1546
1547
1548
1549
1550
1551
1552
1553
1554
1555
1556
1557
1558
1559
1560
1561
1562
1563
1564
1565
1566
1567
1568
1569
1570
1571
1572
1573
1574
1575
1576
1577
1578
1579
1580
1581
1582
1583
1584
1585
1586
1587
1588
1589
1590
1591
1592
1593
1594
1595
1596
1597
1598
1599
1600
1601
1602
1603
1604
1605
1606
1607
1608
1609
1610
1611
1612
1613
1614
1615
1616
1617
1618
1619
1620
1621
1622
1623
1624
1625
1626
1627
1628
1629
1630
1631
1632
1633
1634
1635
1636
1637
1638
1639
1640
1641
1642
1643
1644
1645
1646
1647
1648
1649
1650
1651
1652
1653
1654
1655
1656
1657
1658
1659
1660
1661
1662
1663
1664
1665
1666
1667
1668
1669
1670
1671
1672
1673
1674
1675
1676
1677
1678
1679
1680
1681
1682
1683
1684
1685
1686
1687
1688
1689
1690
1691
1692
1693
1694
1695
1696
1697
1698
1699
1700
1701
1702
1703
1704
1705
1706
1707
1708
1709
1710
1711
1712
1713
1714
1715
1716
1717
1718
1719
1720
1721
1722
1723
1724
1725
1726
1727
1728
1729
1730
1731
1732
1733
1734
1735
1736
1737
1738
1739
1740
1741
1742
1743
1744
1745
1746
1747
1748
1749
1750
1751
1752
1753
1754
1755
1756
1757
1758
1759
1760
1761
1762
1763
1764
1765
1766
1767
1768
1769
1770
1771
1772
1773
1774
1775
1776
1777
1778
1779
1780
1781
1782
1783
1784
1785
1786
1787
1788
1789
1790
1791
1792
1793
1794
1795
1796
1797
1798
1799
1800
1801
1802
1803
1804
1805
1806
1807
1808
1809
1810
1811
1812
1813
1814
1815
1816
1817
1818
1819
1820
1821
1822
1823
1824
1825
1826
1827
1828
1829
1830
1831
1832
1833
1834
1835
1836
1837
1838
1839
1840
1841
1842
1843
1844
1845
1846
1847
1848
1849
1850
1851
1852
1853
1854
1855
1856
1857
1858
1859
1860
1861
1862
1863
1864
1865
1866
1867
1868
1869
1870
1871
1872
1873
1874
1875
1876
1877
1878
1879
1880
1881
1882
1883
1884
1885
1886
1887
1888
1889
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900
1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
2045
2046
2047
2048
2049
2050
2051
2052
2053
2054
2055
2056
2057
2058
2059
2060
2061
2062
2063
2064
2065
2066
2067
2068
2069
2070
2071
2072
2073
2074
2075
2076
2077
2078
2079
2080
2081
2082
2083
2084
2085
2086
2087
2088
2089
2090
2091
2092
2093
2094
2095
2096
2097
2098
2099
2100
2101
2102
2103
2104
2105
2106
2107
2108
2109
2110
2111
2112
2113
2114
2115
2116
2117
2118
2119
2120
2121
2122
2123
2124
2125
2126
2127
2128
2129
2130
2131
2132
2133
2134
2135
2136
2137
2138
2139
2140
2141
2142
2143
2144
2145
2146
2147
2148
2149
2150
2151
2152
2153
2154
2155
2156
2157
2158
2159
2160
2161
2162
2163
2164
2165
2166
2167
2168
2169
2170
2171
2172
2173
2174
2175
2176
2177
2178
2179
2180
2181
2182
2183
2184
2185
2186
2187
2188
2189
2190
2191
2192
2193
2194
2195
2196
2197
2198
2199
2200
2201
2202
2203
2204
2205
2206
2207
2208
2209
2210
2211
2212
2213
2214
2215
2216
2217
2218
2219
2220
222

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, and the advantages thereof, reference is not made to the following descriptions taken in conjunction with the accompanying drawings, wherein like numbers designate like objects, and in which:

FIGURE 1 illustrates an exemplary process system and associated resource allocator in accordance with the principles of the present invention;

FIGURE 2 illustrates a block diagram of a process system implemented as an information management system associated with the resource allocator of FIGURE 1, all in accordance with the principles of the present invention;

FIGURE 3 illustrates a block diagram of a network infrastructure utilized to implement a distributed embodiment of the process system of FIGURES 1 and 2 in association with a centralized implementation of resource allocator, all in accordance with the principles of the present invention;

FIGURE 4 illustrates a block diagram of a data repository infrastructure utilized to implement an advantageous embodiment of the process system of FIGURES 1 to 3 in association with a graphical user interface, all in accordance with the principles of the present invention; and

FIGURE 5 illustrates a flow diagram of an exemplary method of

[illegible]

DETAILED DESCRIPTION OF THE INVENTION

FIGURES 1 through 5, discussed below, and the various
embodiments used to describe the principles of the present
invention in this patent document, are by way of illustration only
and should not be construed in any way to limit the scope of the
invention. Those skilled in the art will understand that the
principles of the present invention may be implemented in any
suitably arranged system, as well as method of operating the same,
for allocating a plurality of resources, both process and human
resources, among a plurality of tasks within a process system.

Turning initially to FIGURE 1, illustrated is an exemplary
process system (generally designated 100, that includes a plurality
of application processes 105; for purposes hereof, "application
process" is defined broadly as a program or a part of a program
that can execute, whether independently of other parts or not, and
is designed for or to meet the needs of the process system 100 --
an application process may suitably consist of low-, mid- or high-
level programs or parts thereof that interact with process system
100) that is associated with a resource allocator (generally
designated 110), all in accordance with the principles of the
present invention. For purposes hereof, the phrase "process
system" means any computer processing system, network of computer

processing systems, or portion thereof that is operable to monitor, control or otherwise supervise a process (e.g., information management system, manufacturing plant, refinery, hotel, restaurant, traffic control, transportation control, emergency services (e.g., police, fire, medical, military, etc.), and the like). According to one advantageous embodiment hereof, process system 100 is a service automation system that is operable to handle multiple and varied customer service systems with web-based, real-time, visualized, intelligent (i.e., self-learning), and control enhancements for industries that require timely delivery of services and resources.

Exemplary resource allocator 110 is operable to allocate a plurality of resources 115 among a plurality of tasks 120 within process system 100, wherein exemplary resources 115 include both human resources and process resources. According to one advantageous embodiment hereof, resource allocator 110 is a general processor that is operable to accept variable service requests and to intelligently apply the required resources to address such requests. Resource allocator 110 illustratively includes a memory 125, a status monitoring controller 130, a resource allocation controller 135 and is associated with a graphical user interface ("GUI," which provides graphical information controls) 140, which cooperatively offer enhancements of real-time, visual, intelligent,

and control functions through web-base connectivity.

Exemplary memory 125 is operable to store a model 145 of process system 100. Exemplary model 145 represents mathematically application processes 105, resources 115, and tasks 120, and also
5 defines various relationships among related ones of application processes 105, resources 115, and tasks 120. According to one advantageous embodiment hereof, memory 125 includes three databases (shown in FIGURE 2), namely, a service database, a control database and a knowledge database. The service database is operable to
10 store information regarding customers, networks, transactions, resources, and communications. The control database is operable to store algorithms, rules, and key elements for decision-making. The knowledge database is operable to provide task related intelligent information to help make optimal decisions, and to acquire and
15 accumulate experience through evaluating results (i.e., artificial intelligence, expert system analysis, neural networks, etc.).

Exemplary status monitoring controller 130 is operable to monitor measurable characteristics associated with ones of process system 100, application processes 105, resources 115, and tasks
20 120. According to one advantageous embodiment hereof, status-monitoring controller 130 is a real-time monitor of updated status of resources, transactions, tasks, and enables human interaction online with other subsystems, allowing a human interface to update

or over-ride the decision-making processes.

Exemplary resource allocation controller 135 is responsive to ones of the monitored measurable characteristics and is operable to: (i) modify ones of the mathematical representations of application processes 105, resources 115, tasks 120, and the defined relationships among related ones of application processes 105, resources 115, and tasks 120; and (ii) allocate ones of resources 115 among ones of tasks 120 within process system 100.

According to one advantageous embodiment hereof, resource allocation controller 135 is operable to interact with available resources and service requests (e.g., tasks) to generate and manage the required service transaction (noting, for instance, that measurable characteristics of resource allocation controller 135 may be associated with management of customers, networks, transactions, resources, and communications, such as service objectives, metrics, and measurements).

Exemplary GUI 140 is a user interface that is operable to transform real-time process system information into an audio or visual format to enable supervisory interaction. According to one advantageous embodiment hereof, GUI 140 is operable to visualize the data and status of external resources, service requests as well as on-going transactions by using graphic displays, audio/video equipment to provide real-time status as well as historical and

statistical information with human interaction.

It should be noted that the principles of the present invention are described with reference to FIGURES 2 to 4 introduce an information management system embodiment of process system 100 of FIGURE 1. Exemplary information management system 100 is introduced by way of illustration only to describe the principles of the present invention and should not be construed in any way to limit the scope of the invention. Turning next to FIGURE 2, illustrated is a conceptual block diagram of information management system 100 associated with a service operation resource allocator 110, all in accordance with the principles of the present invention. Exemplary information management system 100, in addition to service operation resource allocator 110, includes a plurality of application processes 105, namely, a service customer block, and a service management block.

Exemplary service customer block may be a person or a controller; for instance, service customer block may suitably be a person using a computer that is associated with an intranet or the Internet, or it may be an intelligent input/output device associated with equipment to send and receive data using connectivity.

Exemplary service management block includes a plurality of GUIs 140 that provide user interfaces operable to transform real-

time information into an audio or visual format to enable supervisory interaction. Service management block is operable to enable supervisory interaction with flexibility to visualize and control the entire service process flexibly (in a related
5 embodiment, such supervisory interaction may suitably be in detail or in general with zoom in/out functions in a real-time mode).

Exemplary service operation block 110 is a resource allocator that is operable to allocate a plurality of service resources 115 among a plurality of tasks 120 within information management system
10 100. Service resources 115 include both human resources and process resources. According to this embodiment, the human resources may suitably be classified into three categories, namely, operation, administration and management. Exemplary human
15 operation resources include service staff that work with customers or service requests, such as waiters, mechanics, plumbers, painters, electricians, soldiers, technicians, engineers, etc. Exemplary human administration resources include service coordinators, system operators and administrators that support the
20 operations, such as accountants, purchase agents, auditors, receptionists, secretaries, controllers, servicemen, network administrators, etc. Exemplary human management resources include service managers, system managers, and operation managers that manage the process and sub-process systems and make business and

operation decisions, such as it managers, police chiefs, hotel managers, restaurant managers, store managers, officers, executives, etc.

The process resources may suitably be classified into eight categories, namely, hardware, software, databases, communication/connectivity resources, transportation resources, facilities, utilities, and inventories. Exemplary hardware resources include computers, network devices such as switches/routers/hubs, digital/analog sensors, cables, meters, monitors, scopes, audio/video devices, special service tools, etc.

Exemplary software resources include operation systems, network systems, database systems, application programs, graphics interfaces, system utilities, special applications such as artificial intelligence, neural net, system control and data acquisition ("SCADA"), etc.

Exemplary data resources include three databases, namely, (i) service databases 210 that maintains service objects (customers/equipment), service transactions, networks, resources, and communications, (ii) control databases 220 that maintains key attributes, algorithms, instructions, mathematics and rules that manage, monitor and control the operations, and (iii) knowledge databases 225 that maintain on-going real-time knowledge, information and experiences compiling for resource retention and

self-learning process.

Exemplary communication/connectivity resources include local-area and wide-area networks, Internet, telephones/facsimile, mail, etc. Exemplary transportation resources include trucks, cars, boats, airplanes, bikes, motorcycles, railroads, space shuttles, balloons, military vehicles, etc. Exemplary technology resources include service automation technology that combines major technology areas, namely, (i) network technologies in office automation, (ii) human machine interface ("HMI") technologies in industrial automation, and (iii) artificial intelligent technologies. Exemplary facilities resources include computer control/monitor/server rooms, labs, workrooms, offices, towers/antenna, machines/tools, piping, etc. Exemplary utilities resources include electricity, water, fuel, air, chemicals, etc. Exemplary inventory resources include supplies, materials, peripherals, components, ammunition, etc.

An important aspect of the illustrated embodiment is that service operation block 110 provides systematic operation with automatic and responsive control of service activities based on real-time service data and built-in intelligent decisions from model 145 of FIGURE 1. Routine decisions are made by service automation while service operations are on going. The management is able, via GUIs 140, to make responsive decisions and allocate or

utilize service intelligently based on the real-time graphics-enhanced information.

Service operation block 110 is illustratively associated with a plurality of service resources 115 and a plurality of service controls 205. Exemplary service resources 115 may suitably include people, hardware, software, information or facilities, all of which are to be applied to service activities. Exemplary service controls 205 may suitably include status monitoring controller 130, resource allocation controller 135, and model 145, all of FIGURE 1, that work cooperatively to automatically issue service instructions according to defined rules of model 145.

Service control 205 therefore monitors and controls the service resource allocation and utilization as well as service level and matrix for the service operation. Model 145 of service control 205 again represents mathematically service customer 105, service resources 115, and tasks 120, and also defines various relationships among related ones of the same, and includes a service database 210, a control database 220 and knowledge database 225. Any suitably arranged mathematical representation may be used for model 145 or, for that matter, any of the measurable characteristics. Those skilled in the art will readily recognize that such mathematical representations will often be application dependent.

Exemplary service database 210 is operable to store real-time information regarding service customers 105 and service activities.

Service database 210 provides information of service activities to service resources 115 through a plurality of service queues 120.

5 Service database 210 also feeds real-time information to control database 220. According to the present embodiment, service database 210 may suitably be a relational database with flat file structure containing data in a two-dimensional table format.

10 Exemplary control database 220 is operable to store consolidated real-time key attributes of information from service database 210 and also stores pre-defined algorithms (instructions and rules associated with status monitoring controller 130 and resource allocation controller 135) in a proper format. Instructions can be automatically executed according to the rules and real-time key
15 attributes through HMI/SCADA control software. Service control 205 works with control database 220 to carry out defined instructions through HMI/SCADA software. According to the present embodiment, control database 220 is a data file with special format that contains key data and algorithms (instructions and rules associated
20 with status monitoring controller 130 and resource allocation controller 135).

Exemplary knowledge database 225 is operable as a central repository of knowledge data, capturing qualitative and

quantitative information to develop standards of performance in activities that are common regardless of industry. Knowledge data that would serve as a reference point for performance and procedural improvement to provide task related intelligent
5 information used to make decisions optimally, and to acquire and accumulate experience through evaluating results (*i.e.*, artificial intelligence, expert system analysis, neural networks, etc.).

0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
360
370
380
390
400
410
420
430
440
450
460
470
480
490
500
510
520
530
540
550
560
570
580
590
600
610
620
630
640
650
660
670
680
690
700
710
720
730
740
750
760
770
780
790
800
810
820
830
840
850
860
870
880
890
900
910
920
930
940
950
960
970
980
990
1000
1010
1020
1030
1040
1050
1060
1070
1080
1090
1100
1110
1120
1130
1140
1150
1160
1170
1180
1190
1200
1210
1220
1230
1240
1250
1260
1270
1280
1290
1300
1310
1320
1330
1340
1350
1360
1370
1380
1390
1400
1410
1420
1430
1440
1450
1460
1470
1480
1490
1500
1510
1520
1530
1540
1550
1560
1570
1580
1590
1600
1610
1620
1630
1640
1650
1660
1670
1680
1690
1700
1710
1720
1730
1740
1750
1760
1770
1780
1790
1800
1810
1820
1830
1840
1850
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
2110
2120
2130
2140
2150
2160
2170
2180
2190
2200
2210
2220
2230
2240
2250
2260
2270
2280
2290
2300
2310
2320
2330
2340
2350
2360
2370
2380
2390
2400
2410
2420
2430
2440
2450
2460
2470
2480
2490
2500
2510
2520
2530
2540
2550
2560
2570
2580
2590
2600
2610
2620
2630
2640
2650
2660
2670
2680
2690
2700
2710
2720
2730
2740
2750
2760
2770
2780
2790
2800
2810
2820
2830
2840
2850
2860
2870
2880
2890
2900
2910
2920
2930
2940
2950
2960
2970
2980
2990
3000
3010
3020
3030
3040
3050
3060
3070
3080
3090
3100
3110
3120
3130
3140
3150
3160
3170
3180
3190
3200
3210
3220
3230
3240
3250
3260
3270
3280
3290
3300
3310
3320
3330
3340
3350
3360
3370
3380
3390
3400
3410
3420
3430
3440
3450
3460
3470
3480
3490
3500
3510
3520
3530
3540
3550
3560
3570
3580
3590
3600
3610
3620
3630
3640
3650
3660
3670
3680
3690
3700
3710
3720
3730
3740
3750
3760
3770
3780
3790
3800
3810
3820
3830
3840
3850
3860
3870
3880
3890
3900
3910
3920
3930
3940
3950
3960
3970
3980
3990
4000
4010
4020
4030
4040
4050
4060
4070
4080
4090
4100
4110
4120
4130
4140
4150
4160
4170
4180
4190
4200
4210
4220
4230
4240
4250
4260
4270
4280
4290
4300
4310
4320
4330
4340
4350
4360
4370
4380
4390
4400
4410
4420
4430
4440
4450
4460
4470
4480
4490
4500
4510
4520
4530
4540
4550
4560
4570
4580
4590
4600
4610
4620
4630
4640
4650
4660
4670
4680
4690
4700
4710
4720
4730
4740
4750
4760
4770
4780
4790
4800
4810
4820
4830
4840
4850
4860
4870
4880
4890
4900
4910
4920
4930
4940
4950
4960
4970
4980
4990
5000
5010
5020
5030
5040
5050
5060
5070
5080
5090
5100
5110
5120
5130
5140
5150
5160
5170
5180
5190
5200
5210
5220
5230
5240
5250
5260
5270
5280
5290
5300
5310
5320
5330
5340
5350
5360
5370
5380
5390
5400
5410
5420
5430
5440
5450
5460
5470
5480
5490
5500
5510
5520
5530
5540
5550
5560
5570
5580
5590
5600
5610
5620
5630
5640
5650
5660
5670
5680
5690
5700
5710
5720
5730
5740
5750
5760
5770
5780
5790
5800
5810
5820
5830
5840
5850
5860
5870
5880
5890
5900
5910
5920
5930
5940
5950
5960
5970
5980
5990
6000
6010
6020
6030
6040
6050
6060
6070
6080
6090
6100
6110
6120
6130
6140
6150
6160
6170
6180
6190
6200
6210
6220
6230
6240
6250
6260
6270
6280
6290
6300
6310
6320
6330
6340
6350
6360
6370
6380
6390
6400
6410
6420
6430
6440
6450
6460
6470
6480
6490
6500
6510
6520
6530
6540
6550
6560
6570
6580
6590
6600
6610
6620
6630
6640
6650
6660
6670
6680
6690
6700
6710
6720
6730
6740
6750
6760
6770
6780
6790
6800
6810
6820
6830
6840
6850
6860
6870
6880
6890
6900
6910
6920
6930
6940
6950
6960
6970
6980
6990
7000
7010
7020
7030
7040
7050
7060
7070
7080
7090
7100
7110
7120
7130
7140
7150
7160
7170
7180
7190
7200
7210
7220
7230
7240
7250
7260
7270
7280
7290
7300
7310
7320
7330
7340
7350
7360
7370
7380
7390
7400
7410
7420
7430
7440
7450
7460
7470
7480
7490
7500
7510
7520
7530
7540
7550
7560
7570
7580
7590
7600
7610
7620
7630
7640
7650
7660
7670
7680
7690
7700
7710
7720
7730
7740
7750
7760
7770
7780
7790
7800
7810
7820
7830
7840
7850
7860
7870
7880
7890
7900
7910
7920
7930
7940
7950
7960
7970
7980
7990
8000
8010
8020
8030
8040
8050
8060
8070
8080
8090
8100
8110
8120
8130
8140
8150
8160
8170
8180
8190
8200
8210
8220
8230
8240
8250
8260
8270
8280
8290
8300
8310
8320
8330
8340
8350
8360
8370
8380
8390
8400
8410
8420
8430
8440
8450
8460
8470
8480
8490
8500
8510
8520
8530
8540
8550
8560
8570
8580
8590
8600
8610
8620
8630
8640
8650
8660
8670
8680
8690
8700
8710
8720
8730
8740
8750
8760
8770
8780
8790
8800
8810
8820
8830
8840
8850
8860
8870
8880
8890
8900
8910
8920
8930
8940
8950
8960
8970
8980
8990
9000
9010
9020
9030
9040
9050
9060
9070
9080
9090
9100
9110
9120
9130
9140
9150
9160
9170
9180
9190
9200
9210
9220
9230
9240
9250
9260
9270
9280
9290
9300
9310
9320
9330
9340
9350
9360
9370
9380
9390
9400
9410
9420
9430
9440
9450
9460
9470
9480
9490
9500
9510
9520
9530
9540
9550
9560
9570
9580
9590
9600
9610
9620
9630
9640
9650
9660
9670
9680
9690
9700
9710
9720
9730
9740
9750
9760
9770
9780
9790
9800
9810
9820
9830
9840
9850
9860
9870
9880
9890
9900
9910
9920
9930
9940
9950
9960
9970
9980
9990
10000

An important aspect of the illustrated embodiment is that control database 220 serves to provide information service management with visual, intelligent, and control enhancements based on real-time information. In summary, using service database 210, control data base 220 and knowledge database 225, service operation block 110 is operable to allocated a plurality of service resources 115 among a plurality of tasks within information management system 100, and, more specifically, service operation block 110 utilizes a status monitoring controller and a resource allocation controller embodied on databases 210 and 220 in accord with the principles hereof.

Turning now to FIGURE 3, illustrated is a conceptual block diagram of an exemplary network infrastructure utilized to implement a distributed embodiment of process system 100 in association with a centralized implementation of service operation resource allocator 110. Exemplary distributed process system 100

includes a plurality of customers 105, including LAN users 300, intelligent devices 305 (e.g., personal data assistants ("PDAs"), two-way messaging devices, etc.), WAN users 310, Internet users 315, and the like. Those of ordinary skill in the art will
5 recognize that this embodiment and other functionally equivalent embodiments may suitably be implemented by a variety of methods using many different computer, or processing, system platforms.

Conventional computer and processing system architecture is more fully discussed in Computer Organization and Architecture, by
10 William Stallings, MacMillan Publishing Co. (3rd d. 1993); conventional processing system network design is more fully discussed in Data Network Design, by Darren L. Spohn, McGraw-Hill, Inc. (1993); and conventional data communications is more fully
15 discussed in Data Communications Principles, by R.D. Gitlin, J.F. Hayes and S.B. Weinstein, Plenum Press (1992) and in The Irwin Handbook of Telecommunications, by James Harry Green, Irwin Professional Publishing (2nd ed. 1992). Each of the foregoing publications is incorporated herein by reference for all purposes.

Broadly, process system 100 allocates a plurality of process
20 and human resources among a plurality of tasks thereby enabling real-time process automation through mathematical modeling of the human resources and the process resources, and then allocating ones of such resources to perform various tasks within the process

system. For the purposes of the illustrated embodiment, tasks are divided into three categories, namely, service requests, service dispatches and information sharing. A service request may suitably be stored in service databases 210 with priority, location, contents, requirements, contacts, etc. A service dispatch may suitably be stored in control databases 220 and knowledge databases 225 with service level objectives, service metrics/measurements, transaction/actions, status and situations, decision-making processes with real-time responsive, pre-defined, programmed, intelligent, knowledge/experience retention and self-learning characters. Information sharing is a request for computer generated audio/video and print report, e-based, real-time, graphical/visualized, etc.

Turning now to FIGURE 4, illustrated is a conceptual block diagram of a block diagram of an exemplary data repository infrastructure utilized to implement an embodiment of process system 100 and resource allocator/service operation block 110 in association with GUI 140. According to the present embodiment, real-time service information data is obtained and consolidated into control database 220. Exemplary service operation block 110 includes, among other elements, a resource allocation controller 135, which graphical information control system. Again, resource allocation controller 135, which is responsive to the monitored

measurable characteristics of process system 100, is operable to modify ones of the mathematical representations of service customers 105, service resources 115, service tasks 120, and the defined relationships among related ones of the same; to allocate
5 ones of service resources 115 among ones of tasks 120 within process system 100; and to provide a graphical presentation of the service processes.

Graphical information control system 140 of resources allocation controller 135 provides customer management 405a,
10 networking management 410a, transaction management 415a, resource management 420a, and communication management 425a.

With respect to customer management 405a, information associated with computer users and equipment is stored on-line in a customers database 405b. Customer information may suitably be
15 updated either by service personnel, other related databases, or by software utilities, which are operable to collect equipment configuration and utilization in real-time mode. Customer database 405b is illustratively dynamically linked with control database 220 through DDE/ODBC. Customer information may suitably be graphically
20 displayed for management presentation, evaluation, and control.

With respect to network management 410a, information associated with network connectivity and devices is stored in a network database 410b through network servers and/or intelligent

gateway devices. Smart network devices in conjunction with network utility software may suitably monitor and interrogate the network infrastructure providing real-time connectivity information. This information may also dynamically linked with control database 220
5 through DDE/ODBC. The network infrastructure and utilization are then graphically displayed to management in the same way as the customer information.

With respect to transaction management 415a, information associated with service transactions generated by customers and the system may suitably be stored on-line in a transaction database 415b. This transaction information is also dynamically linked with the control database 220 through DDE/ODBC. Consolidated transaction information may be graphically displayed to management.

With respect to resource management 420a, information associated with service resources is compiled in a resource database 420b. The service resources information is also dynamically linked to the control database 220 through DDE/ODBC. The available service resources will be automatically applied to address the service needs according to the predefined instructions
20 and rules. The allocation and utilization of service resources may be graphically displayed to management. Resources such as personnel, hardware, software, information, or facilities to be used in the service may suitably be visualized under resource

management.

With respect to communications management 425a, information associated with the customers, service operation and management is compiled in a communication database 425b. This information is
5 also dynamically linked to the control database 220 through DDE/ODBC. Graphical information control system of resource allocation controller 135 may then execute automatic communication actions between customers, service operation and management based on the communication instructions and rules set in control database
10 220. The communication activities may be displayed to management in real-time mode automatically.

An important aspect of the present embodiment is that communications may suitably be accomplished through telephone, two-
15 way pager, Win 911, RF wireless, or e-mail, which would allow service personnel to access service management and customers.

Turning next to FIGURE 5, illustrated is a flow diagram (generally designated 500) of an exemplary method of operating process system 100 of FIGURES 1 to 4, all in accord with the principles of the present invention. For purposes of illustration,
20 concurrent reference is made to embodiment disclosed with reference to FIGURE 2. It is beneficial to assume that process system 100 is instantiated and fully operational, and for illustrative purposes directed to a raw material refining environment. Further, for

simplicity, assume that there are two human resources available and a plethora of process resources. Thus, exemplary process system 100 controls processing raw materials, and likely controls a control center and associated process stages (not shown; e.g., application processes 105).

A first process stage might include raw material grinders that receive a feed of raw material and grind the same, such as by using a pulverizer or a grinding wheel, into smaller particles of raw material. A second process stage might include a washer that receives the ground raw materials and cleans the same to remove residue from the first stage. A third process stage might include separators that receive the ground, washed raw materials and separate the same into desired minerals and any remaining raw materials. Since this process system and related facility are provided for purposes of illustration only and the principles of such a facility are well known, further discussion of the same is beyond the scope of this patent document and unnecessary.

To begin, resource allocator 110 stores a model 145 of process system 100 in memory (process step 505), model 145 representing mathematically the human resources, the process resources, the application processes 105 (i.e., the control for the grinders, separators and washers, etc.), and relationships among related ones thereof. Resource allocator 110 then monitors these measurable

characteristics and receives service requests (process step 510), and, for the present example, from a particular grinder.

In response to measurable characteristics causing a request for service of the subject grinder, resource allocator 110 evaluates the human resources and allocates one to service the grinder, along with process resources that may be necessary and appropriate to complete the same (process step 515). Resource allocator 110, in response to the servicing of the task, modifies ones of the mathematical representations, first indicating that the human resource is occupied and second indicating the quality with which the task was completed (process step 520).

According to the illustrated embodiment, resource allocator 110 modifies knowledge database 225 to provide updated task related information to help make future decisions concerning the grinder, the allocated human resource, etc., both intelligently and optimally. Resource allocator 110 thereby acquires and accumulates experience through evaluating results (i.e., artificial intelligence, expert system analysis, neural network analysis, etc.). Thus, in a later scenario, should this same human resource be otherwise occupied with another task and this grinder requires a similar service, resource allocator 110 can suitably utilize dynamic knowledge database 225 evaluate available human resources to decide whether to reallocate this same human resource to the

grinder based upon past experience recorded in the associated measurable characteristics and to allocate another human resource to the task left uncompleted. Again, resources, both human and process, are re-usable, re-directable for "next" requests through intelligent decision making sub-process of experience accumulation, analysis, optimization and self-learning. Knowledge database operates as a central repository of knowledge data, capturing qualitative and quantitative information to develop standards of performance in activities that are common regardless of industry.

In conclusion, and in summary, it is readily apparent that systems, as well as methods of operating the same, are disclosed herein for allocating a plurality of resources, both process and human resources, among a plurality of tasks within a process system. An exemplary resource allocator has been introduced that is operable to allocate a plurality of resources among a plurality of tasks within a process system, wherein the process system includes a plurality of application processes. The resource allocator includes a memory, a status-monitoring controller, and a resource allocation controller. An exemplary memory in accord herewith is operable to store a model of the process system, wherein the model (i) represents a mathematically the plurality of application processes, the plurality of resources, and the plurality of tasks, and (ii) defines various relationships among

related ones thereof. An exemplary status-monitoring controller in accord herewith is operable to monitor measurable characteristics associated with ones of the process system, the application processes, the resources, and the tasks. An exemplary resource allocation controller in accord herewith, and in response to ones of the monitored measurable characteristics, is operable to: (i) modify ones of the mathematical representations and (ii) allocate ones of the resources among ones of the tasks within the process system. It should be noted that any resource, whether human or process, that is allocated to a task may suitably be reallocated to another task in short, resources are re-usable, re-directable for "next" requests through intelligent decision making sub-process of experience accumulation, analysis, optimization and self-learning.

Although the present invention has been described in detail, those skilled in the art should understand that they can make various changes, substitutions and alterations herein without departing from the spirit and scope of the invention in its broadest form.